

**Appln No. 10/815,526**  
**Amdt date October 8, 2008**  
**Reply to Office action of July 18, 2008**

**REMARKS/ARGUMENTS**

Claims 1, 3-11 and 13-25 are now in the application. Claims 1, 4, 14, and 24 have been amended. The Applicant respectfully requests reconsideration and allowance of the application in view of the amendments and the following remarks.

**Rejection Under 35 U.S.C. §112**

Claim 14 is rejected under 35 U.S.C. §112 as being indefinite. Specifically, claim 14 depends from claim 12, which has been canceled. The Applicant has amended claim 14 to now depend from claim 1.

In addition, the Applicant has amended claim 4 to now depend from claim 24 instead of cancelled claim 2.

As such and in view of the foregoing, the Applicant respectfully requests that the rejections of the claims under 35 USC §112, second paragraph, be withdrawn.

**Rejection Under 35 U.S.C. §103(a)**

Claims 1, 3-11, 13 and 15-25 are rejected under 35 U.S.C. §103(a) as being unpatentable over Darolia (U.S. Patent No. 6,273,678) in view of Andolfatto et al. (U.S. 6,527,924). The Applicant respectfully traverses these rejections as follows.

First, the Applicant would like to note that each of independent claims 1 and 24 has been amended in reply to the previous Office Action to recite that "*the gaseous compound of the modifier metal is zirconium oxychloride*". In other words, this means that the modifier metal is zirconium and that zirconium metal is deposited simultaneously with the deposition of aluminum. As such, to better set forth the subject matter being claimed, the Applicant has amended to claim 1 to now further recite "that zirconium metal is deposited simultaneously with the deposition of aluminum"; and has amended claim 24 to now further recited "that zirconium metal is deposited simultaneously with the depositing of the aluminum metal."

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In addition, the Applicant notes that the material data relating to zirconium oxychloride, also named zirconyl chloride, of formula  $ZrOCl_2$ , should be apparent to those skilled in the art. This compound has the appearance of a white powder. Its melting point is 150°C, and its boiling point is 210°C.

It should therefore be apparent that above 210°C, this compound will be in the vapor state. However, and contrary to what is asserted by the Examiner, it is not obvious for someone skilled in the art that said compound, once evaporated, would become a precursor of zirconium metal.

In the Office Action, the Examiner rejects claims 1, 3-11, 13 and 15-25 under 35 US §103 (a) as being unpatentable over Darolia in view Andolfatto (US patent 6,527,924). The arguments of the Examiner are detailed in section 14 of the Office Action. The Applicant respectfully believes that it has strong arguments to traverse these obvious rejections as follows.

First of all, the Applicant notes that the Darolia reference (US patent 6,273,678) has already been thoroughly discussed in reply to the first Office Action. The Andolfatto reference does not appear to be directed to an art that is relevant with this invention and with the Darolia reference.

Andolfatto discloses a cathode which can be used for the electrolysis of aqueous solutions in which a water-reduction reaction takes place. It also discloses a process for preparing such a cathode.

More particularly, Andolfatto is directed toward an activated cathode which can be used for the electrolysis of alkaline aqueous solutions of alkali metal chlorides and most particularly for the preparation of chlorine and sodium hydroxide.

The main object of the Andolfatto reference is to decrease the overvoltage of the water reduction reaction and also to increase resistance to corrosion by dissolved chlorine. Thus Andolfatto is directed toward a cathode which can reduce the overvoltage of the water-reducing reaction in alkaline medium.

This cathode consists of an electrically conductive substrate coated with an intermediate layer of oxides based on titanium and on a precious metal of group VIII of the periodic table of

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the elements and with an outer layer of metal oxides comprising titanium, zirconium and a precious metal from group VIII of the periodic table of the elements (column I, line 64 to column 2, line 5).

In the cathode, the intermediate layer advantageously contains titanium oxide and ruthenium oxide. The outer layer of metal oxides preferably contains titanium oxide, zirconium oxide and ruthenium oxide.

Such a cathode may be prepared according to a process with the following steps:

- a) pre-treating the substrate (for instance by a sanding operation) to give its surface-roughness properties,
- b) coating the pretreated substrate using a solution A essentially containing titanium and a precious metal, followed by drying and then calcination of the substrate thus coated, and
- c) coating the substrate obtained in b) using a solution B comprising titanium, zirconium and a precious metal, followed by drying an calcination of the substrate thus coated.

As a result, the electrically conductive substrate is coated with layers of oxides.

Such layers are probably porous in order to have an electric connection between the metallic substrate and the solution surrounding the cathode.

This is the reason why step c) may be replaced by other deposition techniques such as CVD, PVD or plasmas spraying (column 3, lines 52-55).

In addition, Andolfatto teaches that solution B may comprise a mineral salt or organic salt of titanium, of zirconium and of a precious metal with water or in an organic solvent, optionally in the presence of a chelating agent (column 3, lines 2-7). It also mentions that "zirconium salts which can be used are the fluorides and sulfates, zirconyl chloride, zirconyl nitrate and alkoxides such as butyl zirconate. So zirconyl chloride (i.e. zirconium oxychloride) is specifically mentioned.

Thus, even if zirconyl chloride is used by Andolfatto, this will lead to the formation of zirconium oxide (also called zirconia) of formula  $ZrO_2$ . This is an oxide and not zirconium metal. The Andolfatto reference clearly indicates that the layer coveting the metal substrates are oxides. Such oxides may comprise zirconia derived from zirconyl chloride.

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Thus, the Andolfatto reference has nothing to do with the subject of this invention, namely the formation of a protective coating containing aluminum and zirconium metal on a metal substrate. Instead, Andolfatto relates to the preparation of a cathode to be used for the electrolysis of aqueous solutions.

Moreover, the nature of the coating of the substrate in the Andolfatto reference is different. It consists of layers of oxides, the purpose of which is not to protect the substrate, but to give a porous coating to allow electric conduction between the substrate and the solution to be electrolyzed. And the purpose of this coating is to reduce overvoltage of the water-reducing reaction in alkaline medium.

Consequently, the Andolfatto reference pertains to another kind of technique. The reference cannot provide a zirconium metal deposition, but only zirconium oxide deposition.

Consequently, the Andolfatto reference is not relevant either alone or in combination with Darolia.

Furthermore, Andolfatto teaches that the salts to be used are put into a solution with water or an organic solvent (column 3, lines 3-12). As such, it appears to be impossible to obtain zirconium metal from an aqueous solution because of the following equation:

$$E_0^{Zr+IV \rightarrow Zr^0} = -1,539V / ENH$$

ENH = hydrogen normal electrode.

Here again, Andolfatto clearly mentions (column 2, lines 14-16):

*"The outer layer of metal oxides preferably contains titanium oxide, zirconium oxide and ruthenium oxide.*

*Better still, the outer layer consists essentially of ZrTiO<sub>4</sub> accompanied by RuO<sub>2</sub> and optionally ZrO<sub>2</sub> and/or TiO<sub>2</sub>".*

As such, Andolfatto does not mention any coating of zirconium metal and this formation appears to be impossible in Andolfatto.

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Moreover, the Applicant notes that knowing that Zr silicate and ZrOCl<sub>2</sub> may evaporate under conditions, which are not préciséd, is not sufficient to assert that such salts would lead to the introduction of zirconium metal within β-NiAl.

As such, in view of the forgoing, the Applicant respectfully submits that claims 1 and 24 are patentable over Darolia in view of Andolfatto because these references do not teach or suggest the limitations of "zirconium oxychloride" and "that zirconium metal is deposited simultaneously with the deposition of aluminum" as recited in claim 1 and "that zirconium metal is deposited simultaneously with the depositing of the aluminum metal" as recited in claim 24.

Dependent claims 3-11 and 13-23 depend (directly or indirectly) from claim 1. As such, these dependent claims incorporate all the terms and limitations of claim 1 in addition to other limitations, which together further patentably distinguish them over the references made of record.

Dependent claim 25 depends from claim 24. As such, this dependent claim incorporates all the terms and limitations of claim 24 in addition to other limitations, which together further patentably distinguish them over the references made of record.

In addition, concerning section 15 of the present Office Action, the recitation of "in which the active gas at least in part comprises the gaseous compound" in claims 3 and 4 should make these claims independently allowable over the combination of Darolia and Andolfatto.

Concerning section 16 of the present Office Action regarding claims 5 and 25, the Examiner concedes that Darolia does not explicitly teach the process / method in which the said active gas solely comprises or consists of the gaseous compound of the modifier metal.

However, the Examiner contends that Darolia teaches, in column 7, lines 33-36 that "... *the halide gas containing the modifying elements contact[s] the aluminum-containing material and the source of the modifying element to form the corresponding halide gas.*" The Applicant respectfully disagree with this contention because the above quotation does not appear to be accurately quoted because the corresponding passage of Darolia only appear to state that "*the activator and the halide gas containing the modifying element contact the aluminum-containing material and the source of the modifying element to form the corresponding halide gas*". As

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such, this contention of the Examiner may be based on misinterpretation of Darolia, and the Applicant respectfully submits that it would not have been obvious to have modified the method taught by Darolia by using an active gas comprising a single gaseous compound that is both an activator halide and a source of the modifying element as suggested by the Examiner.

In addition, the Applicant would like to note that Darolia uses a halogenated activator and a halogenated precursor of the modifier metal, zirconium tetrachloride. And, Andolfatto deposits oxides on an electrically conductive cathode to oxidize chlorine coming from molecules in solution in order to produce gaseous chlorine.

As such, claims 5 and 25 should be allowable for these additional reasons.

Concerning section 18 of the present Office, the Examiner contends that Andolfatto teaches that the precursor of the modifying element is preferably zirconium oxichloride. The Applicant respectfully disagrees because Andolfatto uses such compound as a precursor of zirconia (zirconium oxide) by virtue of its solubility in water. That is, the Applicant would like to reference the following paragraph of Andolfatto (column 3, lines 3-12):

*solution B is generally prepared by placing in contact, at room (temperature and with stirring, a mineral salt or organic salt of titanium, of zirconium and of a precious metal with water or in an organic solvent, optionally in the presence of a chelating agent. When the placing in contact is exothermic, a bath of ice is used to cool the reaction medium.*

*Advantageously, a mineral salt or organic salt of titanium, of zirconium and of a precious metal is placed in contact with water or in an organic solvent, optionally in the presence of a chelating agent.*

As such, claim 7 should be allowable for this additional reason.

Concerning section 20 of the present Office Action, here again, the Applicant would like to again note that the Applicant is not claiming a protection based on  $\beta$ -NiAl, which was well known before Darolia, but the Applicant is claiming a protection against high temperature oxidation which is based on  $\beta$ -NiAl and zirconium which is obtained through a specific process.

As such, claim 9 should be allowable for this additional reason.

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In view of the foregoing, the Applicant respectfully submits that Claims 1, 3-11 and 13-25 are in condition for allowance. Reconsideration and withdrawal of the rejections are respectfully requested, and a timely Notice of Allowability is earnestly solicited. If there are any remaining issues that can be addressed over the telephone, the Examiner is encouraged to call the Applicants' attorney at the number listed below.

Respectfully submitted,  
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